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EXECUTIVE SUMMARY

AQUEOUS ORGANIC EMISSIONS (PAHs) SURVEY

A. Golomb
Environmental & Inorganic Section
Chemical Research Department

At the request of Central Thermal Services, Environmental Protection Department, an investigation was undertaken to identify and quantify, where possible, organic components - especially polynuclear aromatic hydrocarbons (PAHs) - in waste waters associated with Ontario Hydro's coal-fired generating operations. Many PAHs have been reported in the literature to be present in stack gases of coal-fired power plants. Certain PAHs are of environmental concern because of their reported carcinogenic activity. Accordingly, preliminary studies have been carried out on representative samples of (a) drainage from the Lakeview TGS coal pile and from the Thunder Bay TGS lignite pile, (b) ash sluice waters from Thunder Bay, Lakeview and Nanticoke TGS, and (c) ground water (leachate) from Birchwood Park fly ash disposal site in Mississauga. In addition, leachate extractions of fresh Lakeview (bituminous) and Thunder Bay (lignite) fly ashes were carried out in laboratory shake tests, using deionized water and methylene chloride in each case. GC/MS analysis was used for qualitative identification of dissolved organics present, and quantitatively for PAHs, using available standards. It was found that all of the aqueous samples contained complex mixtures of background (non-PAH) organics, which were relatively hydrophilic (polar) and of low molecular weight compared with the methylene chloride-extractable fly ash organics. Aqueous concentrations of PAHs were low, ranging from 0.05 to 10 µg/L. Phenanthrene and certain of its derivatives were the most widely-found PAHs. None of the PAHs identified have been reported to have carcinogenic activity. Further studies are recommended to gain a better understanding of the origin and nature of the organics - especially, PAHs - found in the various waste waters and laboratory extracts.

job	file	date	report no.
740631-124-592	837.71	November 8, 1984	84-219-K

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To Mr. D.K.A. Gillies
Manager
Environmental Protection
Central Thermal Services

Attn: Dr. A.W. Jackson

AQUEOUS ORGANIC EMISSIONS (PAHs) SURVEY

A. Golomb

A preliminary study has been made of organic compounds present in aqueous emissions from coal-fired generating stations of Ontario Hydro. Particular attention was given to polynuclear aromatic hydrocarbons (PAHs). Representative samples of (i) ash sluice waters, (ii) coal pile drainage and (iii) ground water (leachate) at a fly ash disposal site were analyzed quantitatively for PAHs and semi-quantitatively for background organics by GS/MS. Laboratory extracts of fresh samples of bituminous and lignite ash were prepared in deionized water and in methylene chloride. It was found that all of the aqueous samples contained complex mixtures of background (non-PAH) organics, which were relatively hydrophilic (polar) and of low molecular weight compared with the methylene chloride-extractable fly ash organics. Aqueous concentrations of PAHs were low, ranging from 0.005 to 10 µg/L. Phenanthrene and certain of its derivatives were found to be the most widely-found PAHs. None of the PAHs identified have been reported to have carcinogenic activity. Further studies are recommended.

1. INTRODUCTION

At the request of Central Thermal Services, Environmental Protection Department, an investigation was undertaken/1/ of the presence of organic compounds - especially polynuclear aromatic hydrocarbons (PAHs) - in waste waters associated with coal-fired generating stations of Ontario Hydro. Many PAHs have been reported to be present in stack gases of coal-fired power plants/2/.

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Emission of PAHs is thought to be due to incomplete combustion of carbonaceous material, although the exact mechanism of their formation is unknown. Two possible sources of PAHs may be:

(a) thermal release of PAHs initially present in coal; and/or

(b) pyrosynthesis from smaller organic fragments, eg, acetylene radicals.

It is thought likely that oxygenated, sulphonated and nitro-substituted PAH derivatives may also exist in coal-fired power plant emissions, although these have not yet been positively identified/2/. If present, these polar compounds could have relatively enhanced aqueous solubility compared with the parent PAHs and thus pose an increased health hazard via entry into the aqueous environment. Unfortunately, much less is known at present about these substances compared with the parent PAHs due to analytical difficulties.

As stack gases are diluted and cooled following combustion, rapid adsorption of volatile material, including many organics, takes place on airborne fly ash particles. The smaller, sub-micron particles, with the highest specific surface area, also have the highest specific concentrations of PAHs.

Volatilized PAHs reportedly present/2/ in stack gases, in order of decreasing concentration, include:

fluoranthene
benzo(g,h,i)perylene
benzo(a)pyrene
pyrene
perylene
anthracene
phenanthrene
coronene
methyl (dimethyl) pyrene
methyl fluoranthene
methyl anthracene

Relative carcinogenicities reported for some PAHs tested in mammals/3/ are listed below:

Compound	Carcinogenicity Index*
fluoranthene	-
benzo(g,h,i)perylene	-
benzo(a)pyrene	+++
benzo(e)pyrene	-
pyrene	-
perylene	-
anthracene	-
phenanthrene	-
corcnene	-
7,12-dimethylbenz(a)anthracene	++++
dibenz(a,h)anthracene	+++
benzo(c)phenanthrene	+++
3-methylcholanthrene	++++
dibenzo(a,h)pyrene	+++
dibenzo(a,i)pyrene	+++

*Note: - indicates compound not carcinogenic
+++ indicates compound strongly carcinogenic
++++ indicates compound very strongly carcinogenic

It was anticipated that the product of the concentration of each PAH in a given mixed sample with its carcinogenicity index should give a relative indication of its potential as a health hazard.

2. EXPERIMENTAL

2.1 Work Programme Outline

The study was carried out/1/ to investigate qualitatively and quantitiatively the presence of PAHs in representative samples of each of the following types of waste water:

(a) coal pile drainage (before and after lime neutralization);

(b) ash sluice waters (bottom ash and fly ash);

and

(c) ground water (leachate) at a fly ash disposal site.

For convenience samples were taken from Lakeview TGS (coal pile drainage and bottom ash sluice waters), Nanticoke TGS (fly ash/ bottom ash sluice waters), and from the Birchwood Park ash disposal site (fly ash leachate) which was filled with fly ash from Lakeview TGS.

To determine the amount of extractable organics, expecially PAHs present in fly ash, extracts were prepared of Lakeview TGS fly ash and Thunder Bay TGS fly ash (a) with methylene chloride and (b) with deionized water.

Semi-quantitative analysis (GC/MS) was carried out on each sample to identify as many of the organic components present as possible. In addition, quantitative analysis was carried out on identified PAHs present, using available standards.

2.2 Sampling Procedure

Since (a) PAHs are mainly hydrophobic depending on molecular weight, chemical structure, and degree of substitution by polar groups (eg, nitro, sulphonate, etc),

and (b) it was expected that aqueous concentrations would be very low (ie, in the µg/L range),

care was exercised to avoid contamination of samples by extraneous organic substances during sampling, handling and subsequent analysis. Plastic containers and polymeric filters were scrupulously avoided, and only glass containers and filters used. These had previously been carefully washed with methylene dichloride. Since some of the glass bottles came equipped with plastic screw-on stoppers, these were lined with aluminum foil which had previously been washed with methylene dichloride. Whatman glass microfibre filters, Type GF/C, were used.

A total of 9 aqueous samples were obtained from Lakeview, Nanticoke and Thunder Bay TGS, and a ground water sample was taken from Birchwood Park ash disposal site in Mississauga. These are shown schematically in Figure 1. In addition, samples of fresh hopper fly ash were taken at Lakeview TGS and at Thunder Bay TGS. The sample numbering system used in Figure 1 corresponds exactly with the numbering system used in the Appendix.

2.3 Extraction Procedure for Fly Ash

Each ash was extracted in the laboratory by shaking for 24 h with deionized water (1 L of deionized water to 50 g ash) using a modified MOE coal ash extraction technique/1/. Each ash was also extracted for 24 h in a parallel shake test using methylene chloride as extractant at 500 mL methylene chloride to 25 g fly ash.

Lakeview TGS and Thunder Bay TGS fly ash samples were also extracted with ultrasonication using methylene chloride (50 mL methylene chloride to 10 g fly ash). An outline of the various fly ash extraction procedures is included in Figure 1.

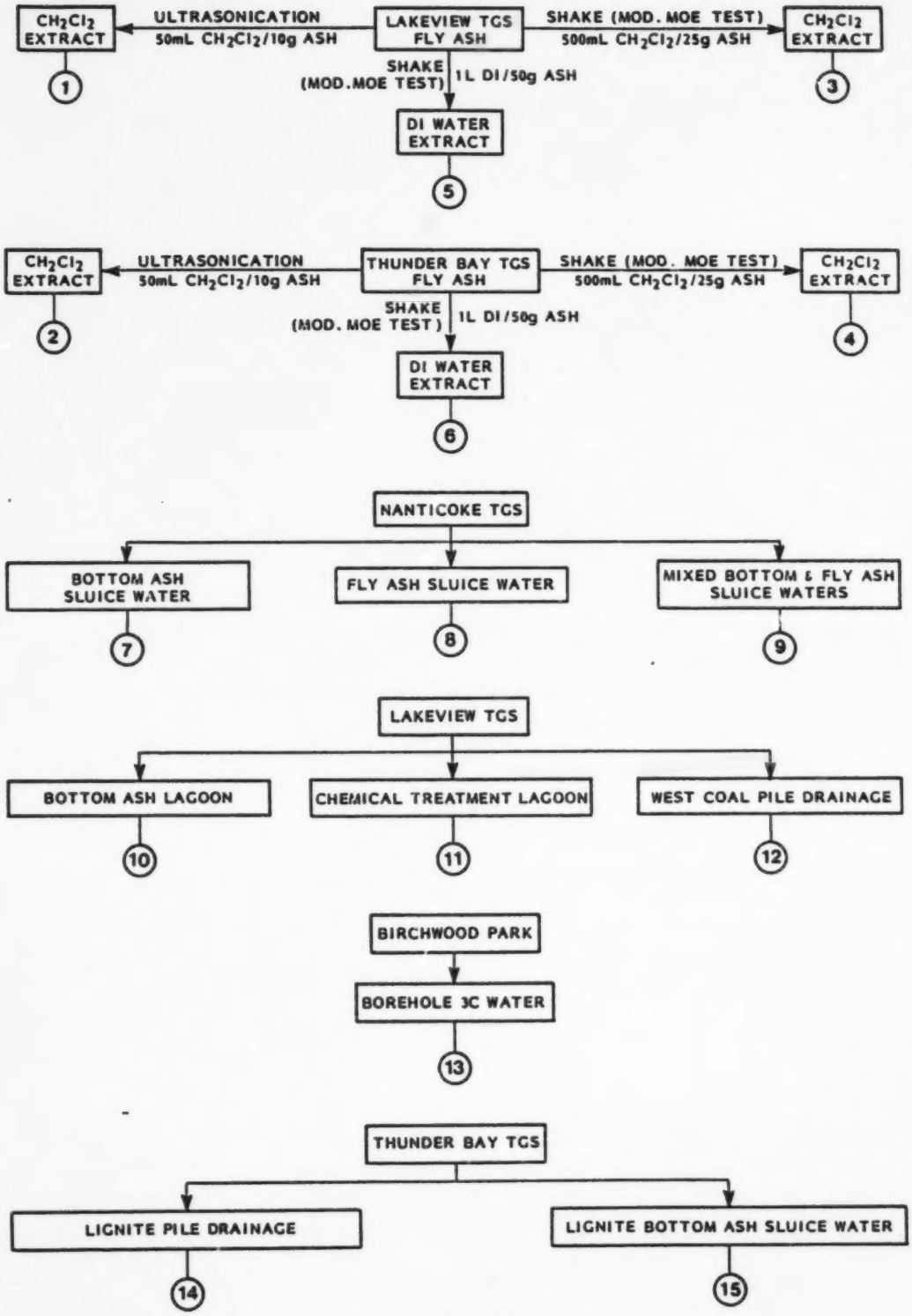

FIGURE 1

SCHEMATIC OF STATION AQUEOUS EMISSIONS AND LABORATORY ASH EXTRACTS

Analytical details are given in the Appendix: qualitative analysis (GC/MS) was carried out on all field samples and laboratory extracts to identify as many of the organic components as possible. Quantitative analysis was carried out on identified PAHs using available standards where possible.

3. SUMMARY OF RESULTS

All analytical results are given in the Appendix/4/. Salient features of the sampling/analysis programme to date are as follows:

- All of the station aqueous effluents contained a complex mixture of organics, as did the fly ash leachate from the ash disposal site and the laboratory fly ash extracts prepared in deionized water and in methylene chloride (15 samples analyzed in all).

- About twenty of the chief organic components of each effluent/fly ash extract were identified and semiquantitatively determined. Concentrations of each species are listed on the 15 individual GC/MS spectrograms (Appendix: Figures 1-15). Levels were found to be mainly in the µg/L to mg/L range.

- PAHs were found to be present in all but 3 of the 15 samples analyzed. Phenanthrene and certain of its derivatives were by far the most commonly determined PAHs. Others include fluoranthene, pyrene, and anthracene derivatives (Appendix: Table III). Generally, none of the PAHs present in the aqueous samples exceeded a concentration of 0.02 µg/L, except for: (i) Thunder Bay TGS lignite pile runoff, which contained many PAHs, the most abundant of which, acetamide,N-(9,10 dihydro-2-phenanthryl) was present at a sample concentration ~10 µg/L, and (ii) Birchwood Park fly ash leachate, which contained a single detectable PAH, 1-isocyanato naphthalene, at a concentration of ~5 µg/L. Contamination by this high level of 1-isocyanato naphthalene is anomalous; it may well result from disposal of waste organic solvents, etc. used, eg, for equipment maintenance during ash placement operations. Levels of PAHs were frequently extremely low (down to 0.005 µg/L) and in such instances special techniques were used to improve peak resolution.

- Mass releases of PAH (phenanthrene) for laboratory extractions of fresh fly ash from Lakeview TGS and Thunder Bay TGS are given in Table I. Methylene chloride was found for Lakeview TGS fly ash (though not for Thunder Bay fly ash) to be a more efficient extractant for PAHs than deionized water.

TABLE I

MASS RELEASES* OF PAH (PHENANTHRENE) FROM FRESH FLY ASH SAMPLES AT (a) LAKEVIEW TGS and (b) THUNDER BAY TGS

Extraction Conditions	(a) Lakeview TGS Fly Ash	(b) Thunder Bay TGS Fly Ash
Methylene chloride (500 mL/25 g fly ash) (Shake Test: Modified MOE Procedure)	0.77 µg/kg	0.38 µg/kg
Deionized water (1 L/50 g fly ash) (Shake Test: Modified MOE Procedure)	0.12 µg/kg	0.38 µg/kg
Methylene chloride (50 mL/10 g fly ash) (Ultrasonication)	0.68 µg/kg	ND+

* All mass releases are expressed in µg/kg of fresh fly ash

\+ ND = no PAH detected

- All laboratory extractions, whether done in methylene chloride or deionized water, were found to remove less than 1 µg of PAH (phenanthrene) per kg of fresh fly ash.
- Thunder Bay TGS lignite pile runoff (Appendix: Figure 14) was by far the most abundant of the station aqueous effluent samples in terms of PAH content - both in the variety and quantity of PAH species present.
- In addition to PAHs, a number of samples were found to contain some hydrocarbon oil. These are listed below.
  - Thunder Bay lignite pile runoff,
  - Methylene chloride extracts (modified MOE extraction procedure) of fresh Lakeview TGS and Thunder Bay TGS fly ashes,
  - Deionized water extract (modified MOE extraction procedure) of Thunder Bay TGS fly ash,
  - Lakeview TGS chemical treatment lagoon.

Of these, the Thunder Bay lignite pile runoff sample contained by far the greatest quantity of oil (Appendix: Figure 14), which also had a significantly greater GC retention time than the other oils. Presence of oil in coal- and ash-related aqueous samples is not unexpected. Waste turbine oil, lubricating oils and low-PCB transformer oil are infrequently discharged batchwise on the Thunder Bay lignite pile. Waste transformer oil is occasionally applied to the Lakeview coal pile for dust suppression under winter conditions when water cannot be sprayed. Fuel oil is burned prior to start-up of coal-fired stations, and at such times products of incomplete oil combustion could become absorbed on fly ash in the precipitators. Presence of high levels of PAHs in some fuel oils (Appendix: Table IV) has previously been noted/5,6/.

- The wide spectrum of organic components (besides PAHs) found in the field and laboratory samples fall into two broad categories: (a) hydrophilic and (b) hydrophobic species. From the chromatograms of aqueous samples, it is evident that the organic species present are predominantly of a hydrophilic or polar nature and include organic acids, bases, aldehydes, esters and other organics of relatively low molecular weight. From the chromatograms of methylene chloride extracts of fly ashes, on the other hand, enrichment of relatively high molecular weight aliphatic and aromatic hydrocarbons is apparent.

- The organic compounds (including PAHs) found in the sample of fly ash leachate taken from the ash disposal site at Birchwood Park, Mississauga (completed in 1974), were entirely different from those found in the aqueous extract prepared in the laboratory from fresh fly ash sampled at Lakeview TGS. This is interpreted to indicate that (a) the organics originally present in fly ash underwent decomposition or were leached away after several years' landfill disposal, and/or (b) the organics found in the borehole sample may have originated in the upgradient regime of the local ground water supply, or from industrial solvents that may have been disposed of locally.

- The Nanticoke TGS mixed fly ash and bottom ash sluice water contained two components (benzenemethanol,AR-ethenyl- and 1,2-benzenedicarboxylic acid, butyl2-methylpropyl ester) that were major components of the Station's bottom ash sluice water. One component of the mixed sluice water (borinic acid, diethyl-,methylester) was also a component of the Station's fly ash sluice water. The PAH phananthrene was determined in all three Nanticoke TGS ash sluice waters.

- The only PAHs found in the course of the preliminary survey for which carcinogenicity information is available are phenanthene, pyrene and fluoranthene - all of which have been reported/1/ as being non-carcinogenic in tests with mammals. We have no biological information available on the numerous other PAHs found.

4.0 RECOMMENDATIONS

1. It is recommended that a more detailed chemical characterization be carried out on Thunder Bay TGS lignite pile drainage, in which an abundance of organic compounds was found, many of which proved to be PAHs. If available, samples of waste heavy oils discharged on the pile should be obtained and analyzed for comparison.

2. Further studies of Lakeview TGS fly ash should be carried out to establish the reason for the great dissimilarity between the chemistry of organics present in fresh fly ash and those identified in the landfilled ash (ie at Birchwood Park) ten years or so after ash placement.

3. The chemistry of organics present in other ash landfill sites should be studied and compared with the results from Birchwood Park to determine if the results are site specific.

Approved by:

O.A. Kupcis
Manager
Chemical Research Dept

Prepared by:

A. Golomb
Engineer
Environmental & Inorganic
Research Section

Reviewed by:

D.J. Dodd
Supervising Engineer
Environmental & Inorganic
Research Section

AG:km/njm

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APPENDIX A

GC/MS ANALYTICAL RESULTS

1. OBJECTIVE

The objective of this work was to carry out some preliminary testing to characterize the organic content of fly ash and waters exposed to this material. The target compounds were polyaromatic hydrocarbons (PAH) and other principal background organic species. The type of samples analyzed included: fly ash and bottom ash, borehole water from ash disposal sites, ash sluicing water, water fly ash settling ponds, shake test aqueous extracts, and coal pile run-off. These samples were collected from Lakeview TGS, Thunder Bay TGS, Nanticoke TGS, and Birchwood fly ash disposal site, Mississauga.

2. SAMPLES

The following samples were submitted:

CODE	ORIGIN	TYPE
1	LTGS	10 g F.A. - 50 mL CH_2Cl_2
2	TBTGS	10 g F.A. - 50 mL CH_2Cl_2
3	LTGS	25 g F.A. - 500 mL CH_2Cl_2
4	TBTGS	25 g F.A. - 500 mL CH_2Cl_2
5	LTGS	50 g F.A. - 1 L water
6	TBTGS	50 g F.A. - 1 L water
7	NTGS	Bottom ash sluice water
8	NTGS	Fly ash sluice water
9	NTGS	Fly ash and bottom ash mixed sluice water
10	LTGS	Bottom ash lagoon
11	LTGS	Chemical treatment lagoon
12	LTGS	West coal pile drainage
13	Birchwood FA Park	Borehole sample
14	TBTGS	Lignite pile run-off
15	TBTGS	Lignite bottom ash sluice water

3. EXPERIMENTAL

The analytical method used was the US EPA method 625 for priority pollutants (Base/Neutrals, Acids, and Bases) Federal Register/Volume 44, No. 233 - December 3, 1979. Besides PAH, this method is applicable to phenols, pesticides, PCB's, and a large number of hydrophobic organic species. Water samples were collected and stored in glass containers fitted with screw caps lined with aluminum foil. One litre subsamples were taken and the organics extracted by liquid/liquid extraction into dichloromethane (CH_2Cl_2). The extraction procedure was repeated 3x each with the sample pH adjusted to 11, 7, and 4. The CH_2Cl_2 fractions were combined, dried over Na_2SO_4 and the volume reduced to about 20 mL in a special evaporator (Kuderna-Danish concentrating evaporator) followed by blow-down to 1 mL. The 1 mL of concentrate was submitted for GC-MS analysis.

The solid ash samples were extracted using two different techniques. The first extraction procedure required 10 g of ash to be ultrasonified with 50 mL of CH2C12 in a 300 mL Berzelius beaker using a Branson Cell Disruptor (Head System Ultrasonics, Inc, 350 watt, fitted with 1.27 cm horn). The second extraction procedure required 25 g of ash to be shaken with 500 mL of CH2C12 for 24 hrs. The organic phases from both extractions were filtered through a glass filter of nominal pore size 0.45 u diameter and the volume reduced in the same manner as above.

The instrumentation used was a Finnigan 4023 quadrapole mass spectrometer and an Incos data system. The concentrated sample extracts were chromatographed on a 30 meter fused silica capillary column coated with methyl-phenyl silicone material (SPB-5). A splittless injection technique was used.

Two standard calibration mixtures were prepared and these used to calibrate the response of the mass spectrometer and to evaluate the recoveries of organic species from aqueous solution. A mixture of Base/Neutral compounds was purchased from a local chromatography supply house, and a mixture of polynuclear aromatic hydrocarbons were prepared from primary PAH standards available in our laboratory. The chromatograms of the standards were processed and calibration factors determined for individual PAH's. For PAH's which were identified in sample chromatograms but for which an authentic standard was not available, the calibration factors were estimated using a factor calculated from the average of chemically similar compounds. For non-PAH materials an average calibration factor was computed from the response of all priority pollutant species and this factor used to estimate the concentrations of the non-PAH species found in all sample extracts.

4. RESULTS AND DISSCUSION

4.1 spiked Recoveries - The recoveries of individual PAH's and priority pollutant species made to 20 ug/L in water and extracted using the same technique as the samples are listed in Table 1 & 2. The recoveries for most compounds were excellent.

4.2 Sample Analysis (PAHs) - The chromatograms of all sample extracts are shown in Figures 1 through 16. Approximately 20 of the most abundant species found in each chromatogram besides all PAH's were identified and have been listed with each chromatogram. In the case of PAH's, quantitative results are reported, and in the case of non-PAH only semi-quantitative information is provided. A list of the PAH's found in the samples can be found in Table 3. Significant quantities of PAH were found in all CH2C12 extracts of the solid ash samples, and small quantities or amounts lower than the detection limits in all other samples exept for sample 14, TBTGS lignite coal pile run-off. The latter contained relatively large quantities and a variety of PAH species. In addition to the PAH, the sample extract contained a large amount of oil which appears in the chromatogram (see Figure 14) as a hump or envelope. A similar

oil envelop was found in samples 3,4,6, and 11. The oil envelope appears at an earlier retention time in these samples compared to sample 14 indicating that the LTGS extractable oil is lighter than that found in the TBTGS sample. PAH's have been indicated and quantified in light and heavy oil samples submitted by various other clients for analysis. The results of one such analysis are listed in Table 4. As shown by the data, heavy oils may contain high concentrations of PAH, and the high levels found in sample 14 relative to the others may suggest that the lignite coal pile at TBTGS has been exposed to a heavy oil spray.

4.3 Other Organic Species - As indicated above the 20 of the most predominant organic species found in the sample extracts are listed on the sample chromatograms. Since there was no requirement to source or characterize the non-PAH content of the samples the disscussion of the raw data will include only following general observations:

- The amount of organic material extractable from fly ash by organic solvent is much greater than for water. This is evident when one compares the chromatograms of the shake test samples using water and CH2C12 as an extracting solvent.

- The kind of organic material extractable into water is significantly different from that which can be extracted using organic solvent, ie, water enriches the polar and ionic organics such as acids, bases, aldehydes, esters, and lower molecular weight organics. The enrichment of hydrophilics is manifested in the chromatograms of water shake test extracts, sluice water, fly ash park borehole water, and lagoon water by a small number of early eluting chromatographic peaks.

- Organic species exposed to the environment undergo chemicals, biochemical, and physical changes. Sample extracts from fresh fly ash may contain a mix of organic species significantly different from a fly ash disposal site sample.

R.E. Massey

R.E. Massey
Chemist - Analytical Methods
Analytic Services Section
(122+7100)

TABLE 1 Recoveries of PAH form AQUEOUS SOLUTION - Solutions made to 20 ug/L in individual PAH's and extracted using standard procedure.

PAH	% RECOVERED
Acenaphthylene	90
9 H Fluorene	100
Anthracene	71
Pyrene	99
Benz(A)Anthracene	93
Chrysene	100
Beno(K)Fluoranthene	110
Benzo(A)Pyrene	90
Benzo(Ghi)Perylene	120
Dibenz(a,h)anthracene	103

TABLE 2 Recoveries of Piority Pollutant Base/Neutral Compounds from Aqueous Solution

COMPOUND	% RECOVERED
1,2 dichlorobenzene	50
1,3 dichlorobenzene	54
Bis (2 chloroethoxy) methane	105
Naphthalene	76
Hexachlorobutadiene	49
2,4 dinitrotoluene	110
Diethyl phthalate	104
Hexachlorobenzene	105

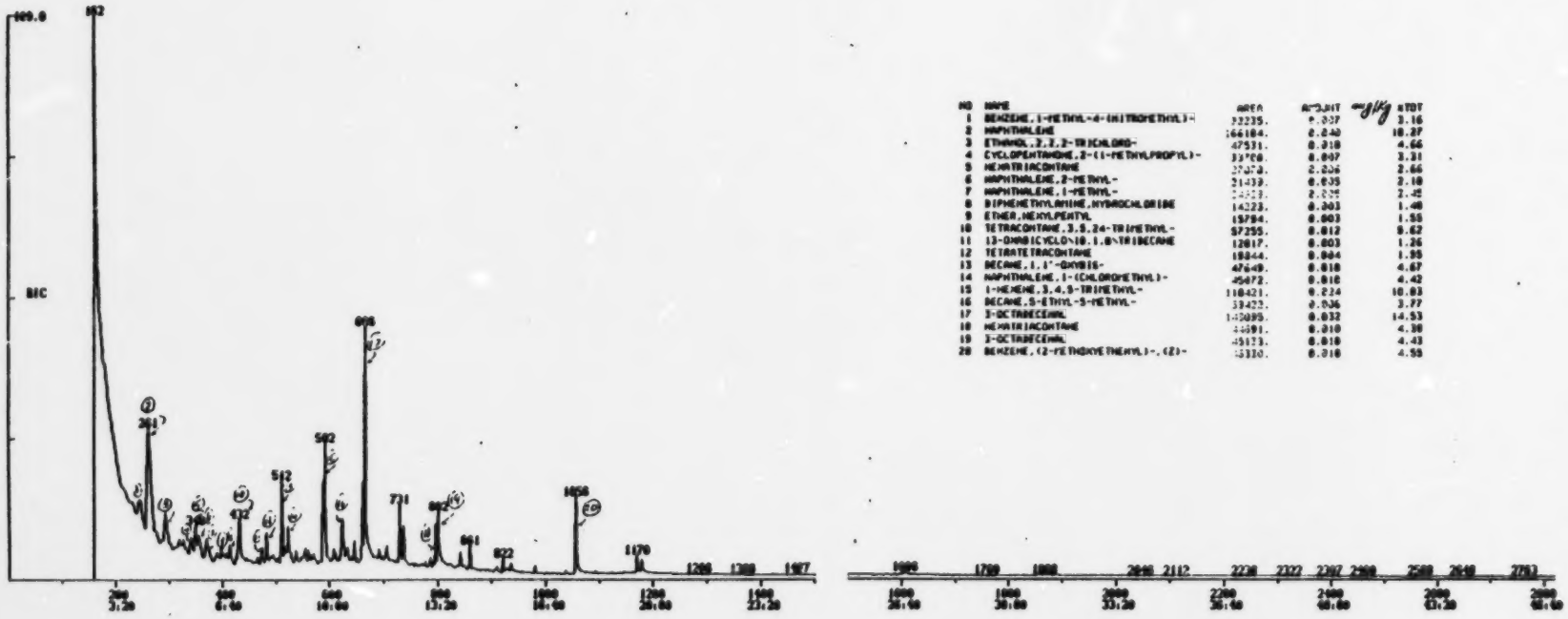

FIGURE 1

LAKEVIEW TGS FLY ASH/DICHLOROMETHANE EXTRACT
(10g SONIFIED WITH 50 mL CH_2Cl_2)

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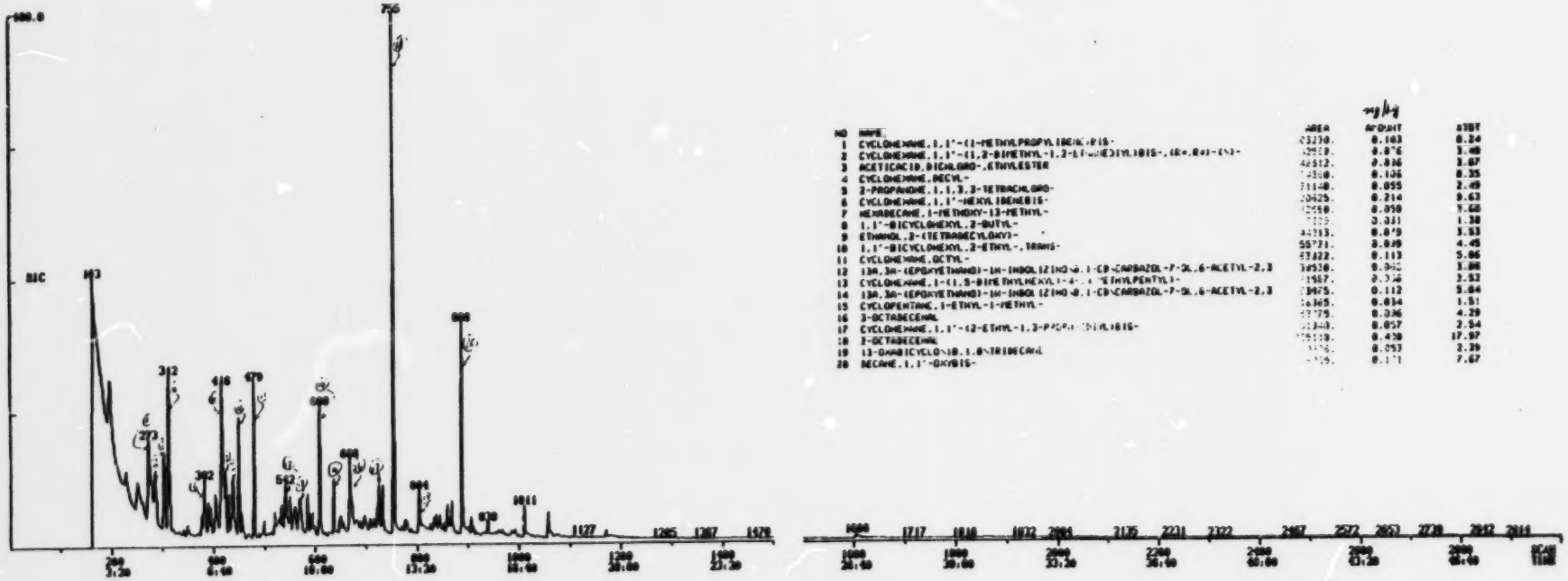

NO	NAME	AREA	ng/kg AMOUNT	RT
1	CYCLOHEXANE,1,1'-(1-METHYLPROPYLIDENE/PIS-	23230.	0.103	0.24
2	CYCLOHEXANE,1,1'-(1,2-DIMETHYL-1,2-ET-[illegible]DIYL)BIS-,(R*,R*)-(+)-	2519.	0.07E	3.48
3	ACETICACID,DICHLORO-,ETHYLESTER	42312.	0.036	3.87
4	CYCLOHEXANE,DECYL-	7[illegible].	0.136	8.35
5	2-PROPANONE,1,1,3,3-TETRACHLORO-	31140.	0.055	2.49
6	CYCLOHEXANE,1,1'-HEXYLIDENEBIS-	20425.	0.214	9.63
7	HENDECANE,1-METHOXY-13-METHYL-	12550.	0.050	9.68
8	1,1'-BICYCLOHEXYL,2-BUTYL-	7[illegible].	0.031	1.38
9	ETHANOL,2-(TETRADECYLOXY)-	44313.	0.079	3.53
10	1,1'-BICYCLOHEXYL,2-ETHYL-,TRANS-	55721.	0.039	4.45
11	CYCLOHEXANE,OCTYL-	47422.	0.113	5.06
12	13A,3A-(EPOXYETHANO)-1H-INDOLIZINO-8,1-CD-CARBAZOL-7-OL,6-ACETYL-2,3	34530.	0.[illegible]	3.88
13	CYCLOHEXANE,1-(1,5-DIMETHYLHEXYL)-4-(4-ETHYLPENTYL)-	11567.	0.[illegible]	3.53
14	13A,3A-(EPOXYETHANO)-1H-INDOLIZINO-8,1-CD-CARBAZOL-7-OL,6-ACETYL-2,3	13475.	0.112	5.84
15	CYCLOPENTANE,1-ETHYL-1-METHYL-	16345.	0.034	1.51
16	3-OCTADECENAL	47175.	0.106	4.29
17	CYCLOHEXANE,1,1'-(2-ETHYL-1,3-PROPA[illegible]DIYL)BIS-	21[illegible].	0.057	2.54
18	2-OCTADECENAL	175113.	0.430	17.97
19	13-DIAZABICYCLO-10.1.0-TRIDECANE	[illegible].	0.053	2.35
20	DECANE,1,1'-OXYBIS-	[illegible].	0.171	7.67

FIGURE 2

THUNDER BAY TGS FLY ASH/DICHLOROMETHANE EXTRACT
(10 g SONIFIED WITH 50 mL CH_2CL_2)

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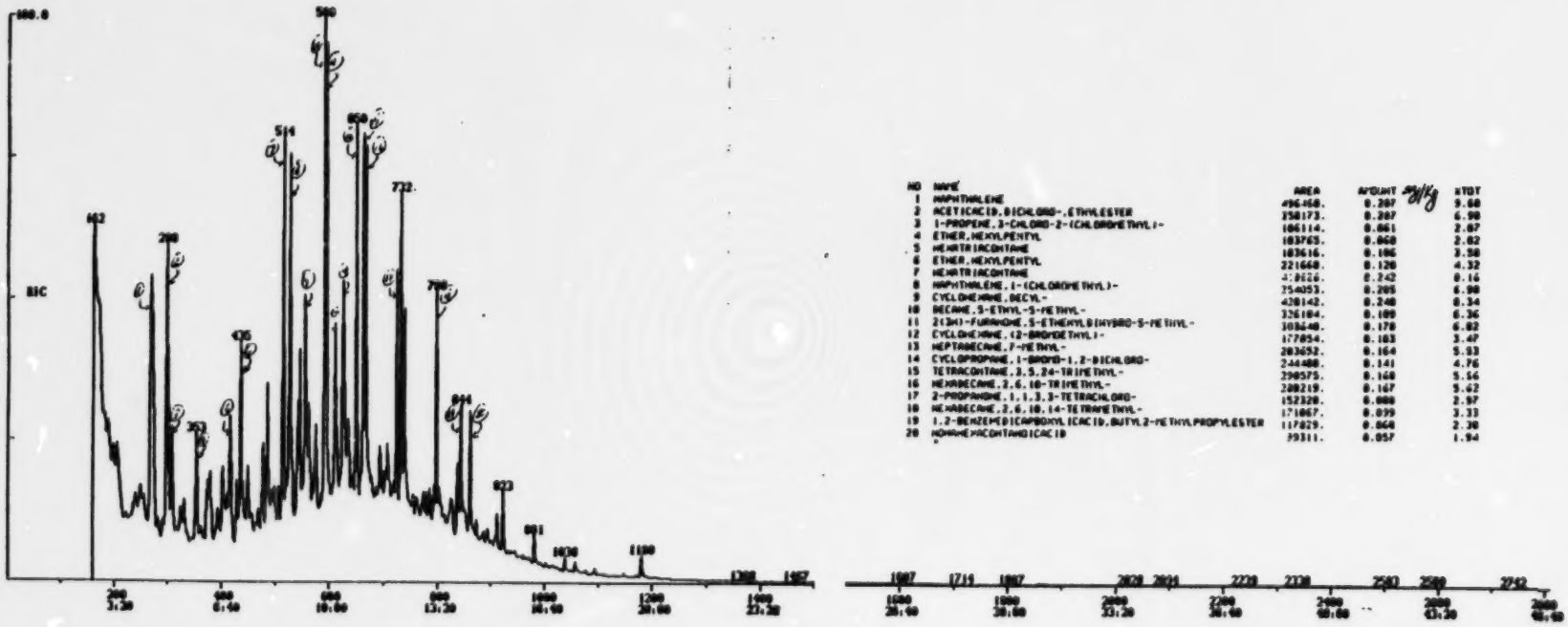


NO	NAME	AREA	AMOUNT ng/g	%TOT
1	NAPHTHALENE	496460.	0.287	9.60
2	ACETIC ACID, DICHLORO-, ETHYL ESTER	358173.	0.207	6.98
3	1-PROPENE, 3-CHLORO-2-(CHLOROMETHYL)-	106114.	0.061	2.07
4	ETHER, HEXYL PENTYL	103763.	0.060	2.02
5	HEXATRIACONTANE	183616.	0.106	3.58
6	ETHER, HEXYL PENTYL	221660.	0.128	4.32
7	HEXATRIACONTANE	41[illegible]26.	0.242	8.16
8	NAPHTHALENE, 1-(CHLOROMETHYL)-	354053.	0.205	6.90
9	CYCLOHEXANE, DECYL-	420142.	0.243	8.34
10	DECANE, 5-ETHYL-5-METHYL-	326104.	0.189	6.36
11	2(3H)-FURANONE, 5-ETHENYLDIHYDRO-5-METHYL-	303648.	0.176	6.02
12	CYCLOHEXANE, (2-BROMOETHYL)-	177854.	0.103	3.47
13	HEPTADECANE, 7-METHYL-	283652.	0.164	5.53
14	CYCLOPROPANE, 1-BROMO-1,2-DICHLORO-	244488.	0.141	4.76
15	TETRACONTANE, 3,5,24-TRIMETHYL-	290575.	0.168	5.66
16	HEXADECANE, 2,6,10-TRIMETHYL-	280219.	0.162	5.46
17	2-PROPANONE, 1,1,3,3-TETRACHLORO-	152320.	0.088	2.97
18	HEXADECANE, 2,6,10,14-TETRAMETHYL-	171067.	0.099	3.33
19	1,2-BENZENEDICARBOXYLIC ACID, BUTYL 2-METHYLPROPYL ESTER	117029.	0.068	2.28
20	NONANEXACONTANOIC ACID	99311.	0.057	1.94

FIGURE 3

LAKEVIEW TGS FLY ASH/DICHLOROMETHANE EXTRACT
(25 g SHAKEN WITH 500 mL CH_2Cl_2)

164794 RD

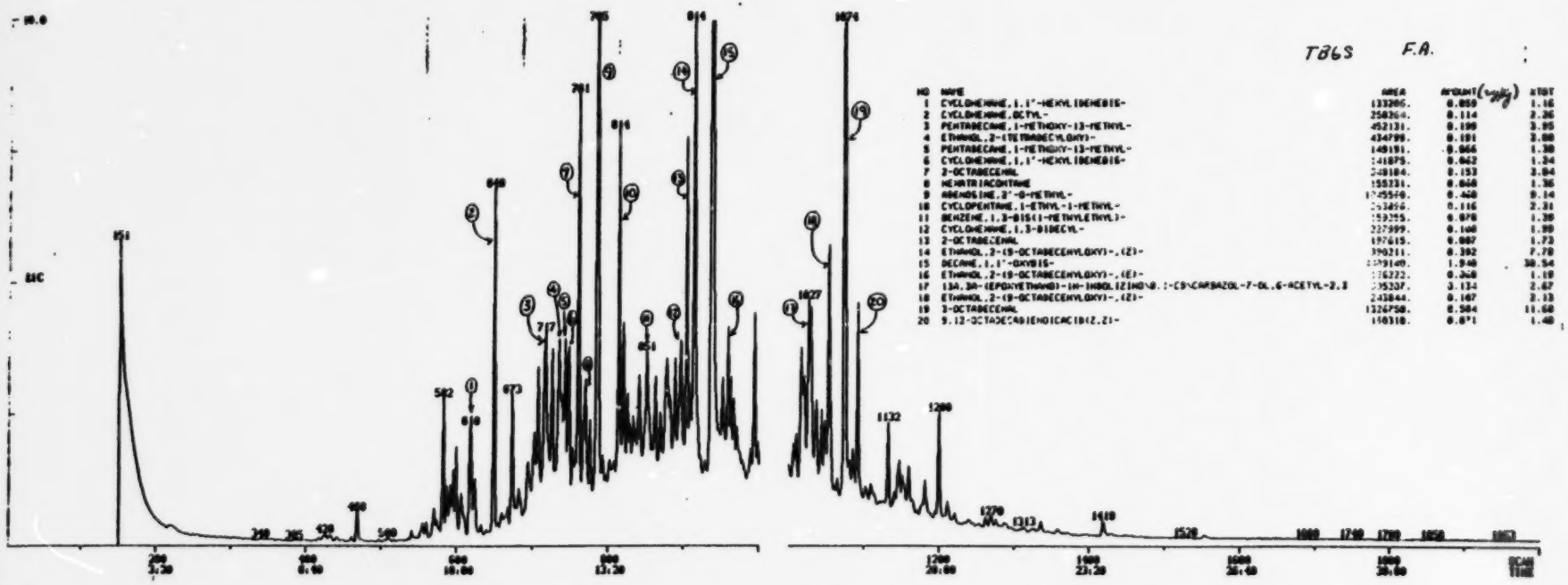
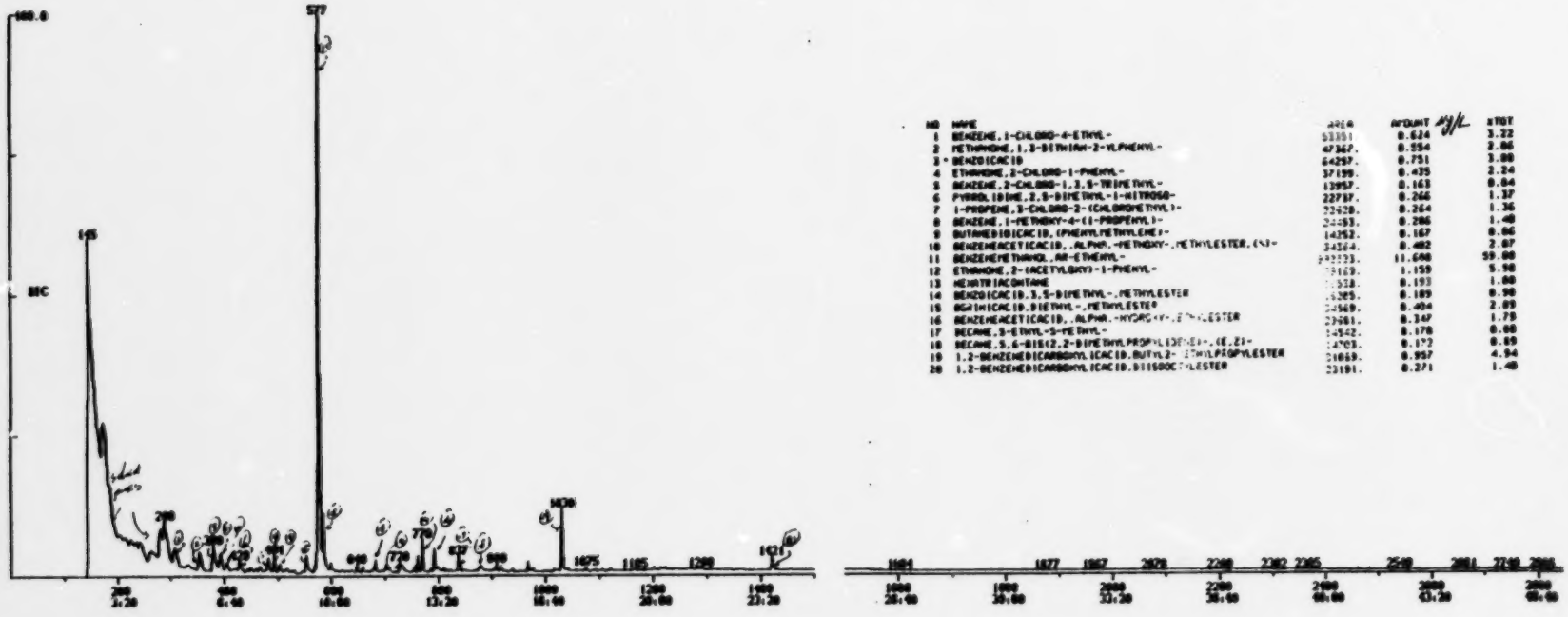

TBGS F.A.
NO NAME AREA AMOUNT(ng/g) %TOT
1 CYCLOHEXANE,1,1'-HEXYLIDENEBIS- 133205. 0.059 1.16
2 CYCLOHEXANE,OCTYL- 258364. 0.114 2.26
3 PENTADECANE,1-METHOXY-13-METHYL- 452131. 0.199 3.95
4 ETHANOL,2-(TETRADECYLOXY)- 434799. 0.191 3.80
5 PENTADECANE,1-METHOXY-13-METHYL- 149191. 0.066 1.30
6 CYCLOHEXANE,1,1'-HEXYLIDENEBIS- 141875. 0.062 1.24
7 2-OCTADECENAL 348184. 0.153 3.04
8 HEXATRIACONTANE 155731. 0.068 1.36
9 ADENOSINE,2'-O-METHYL- 1455548. 0.640 12.14
10 CYCLOPENTANE,1-ETHYL-1-METHYL- 263856. 0.116 2.31
11 BENZENE,1,3-BIS(1-METHYLETHYL)- 159255. 0.070 1.39
12 CYCLOHEXANE,1,3-DIDECYL- 227899. 0.100 1.99
13 2-OCTADECENAL 197615. 0.087 1.73
14 ETHANOL,2-(9-OCTADECENYLOXY)-,(Z)- 390211. 0.392 7.78
15 DECANE,1,1'-OXYBIS- 1779140. 1.948 38.54
16 ETHANOL,2-(9-OCTADECENYLOXY)-,(E)- 176222. 0.368 1.19
17 13A,3B-(EPOXYETHANO)-1H-INDOLIZINO[8,1-CD]CARBAZOL-7-OL,6-ACETYL-2,3 295237. 0.134 2.67
18 ETHANOL,2-(9-OCTADECENYLOXY)-,(Z)- 243844. 0.107 2.13
19 3-OCTADECENAL 1326758. 0.584 11.68
20 9,12-OCTADECADIENOICACID(Z,Z)- 160318. 0.071 1.40

FIGURE 4

THUNDER BAY TGS FLY ASH/DICHLOROMETHANE EXTRACT
(25 g SHAKEN WITH 500 mL CH_2Cl_2)

164795 RD

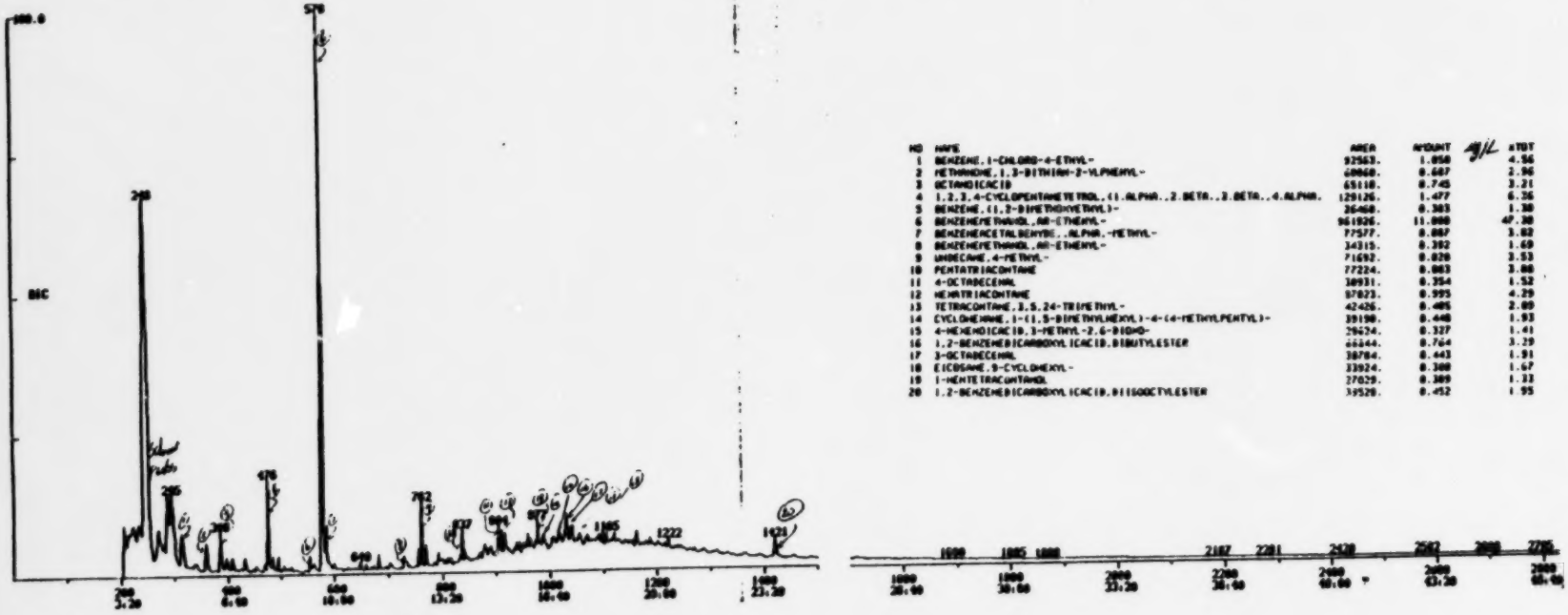


NO	NAME	AREA	AMOUNT µg/L	%TOT
1	BENZENE,1-CHLORO-4-ETHYL-	53351	0.624	3.22
2	METHANONE,1,3-DITHIAN-2-YLPHENYL-	47367.	0.554	2.86
3	BENZOIC ACID	64257.	0.751	3.88
4	ETHANONE,2-CHLORO-1-PHENYL-	37199.	0.435	2.24
5	BENZENE,2-CHLORO-1,3,5-TRIMETHYL-	13957.	0.163	0.84
6	PYRROLIDINE,2,5-DIMETHYL-1-NITROSO-	22737.	0.266	1.37
7	1-PROPENE,3-CHLORO-2-(CHLOROMETHYL)-	22428.	0.264	1.36
8	BENZENE,1-METHOXY-4-(1-PROPENYL)-	24253.	0.286	1.48
9	BUTANEDIOIC ACID,(PHENYLMETHYLENE)-	14252.	0.167	0.86
10	BENZENEACETIC ACID,.ALPHA.-METHOXY-,METHYLESTER,(S)-	34264.	0.402	2.07
11	BENZENEMETHANOL,AR-ETHENYL-	222223.	11.698	59.98
12	ETHANONE,2-(ACETYLOXY)-1-PHENYL-	9869.	1.159	5.98
13	HEXATRIACONTANE	1538.	0.193	1.00
14	BENZOIC ACID,3,5-DIMETHYL-,METHYLESTER	1385.	0.189	0.98
15	AGATHIC ACID,DIETHYL-,METHYLESTER*	24569.	0.404	2.09
16	BENZENEACETIC ACID,.ALPHA.-HYDROXY-,ETHYLESTER	23681.	0.347	1.79
17	DECANE,3-ETHYL-5-METHYL-	14542.	0.178	0.92
18	DECANE,5,6-BIS(2,2-DIMETHYLPROPYLIDENE)-,(E,E)-	14703.	0.172	0.89
19	1,2-BENZENEDICARBOXYLIC ACID,BUTYL 2-ETHYLPROPYLESTER	21869.	0.937	4.84
20	1,2-BENZENEDICARBOXYLIC ACID,DIISOOCTYLESTER	23191.	0.271	1.40

FIGURE 5

LAKEVIEW TGS SHAKE TEST/AQUEOUS EXTRACT

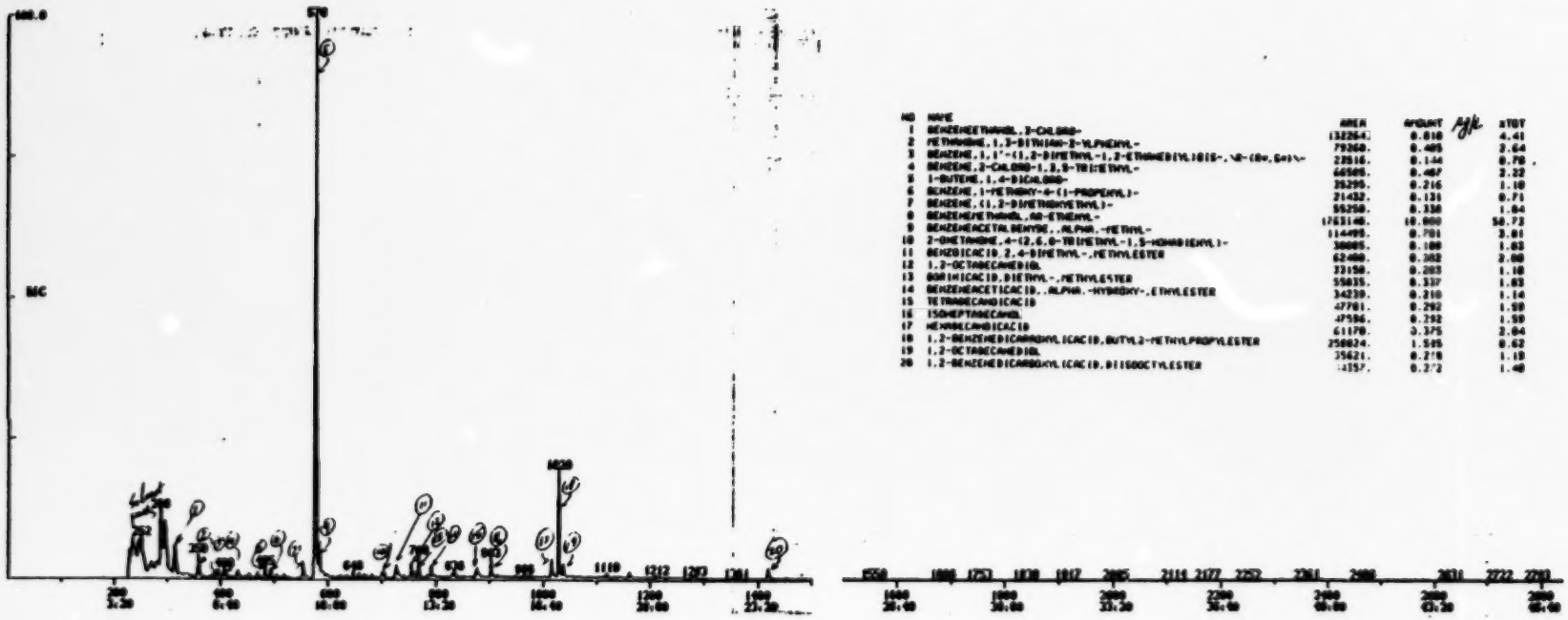
164796 RD



NO	NAME	AREA	AMOUNT	ug/L	%TOT
1	BENZENE, 1-CHLORO-4-ETHYL-	92563.	1.850		4.56
2	METHANONE, 1,3-DITHIAN-2-YLPHENYL-	60860.	0.607		2.96
3	OCTANOIC ACID	65110.	0.745		3.21
4	1,2,3,4-CYCLOPENTANETETROL, (1.ALPHA.,2.BETA.,3.BETA.,4.ALPHA.	129125.	1.477		6.36
5	BENZENE, (1,2-DIMETHOXYETHYL)-	26460.	0.303		1.30
6	BENZENEMETHANOL, AR-ETHENYL-	961926.	11.000		47.38
7	BENZENEACETALDEHYDE, .ALPHA.-METHYL-	77577.	0.887		3.82
8	BENZENEMETHANOL, AR-ETHENYL-	34315.	0.392		1.69
9	UNDECANE, 4-METHYL-	71692.	0.820		3.53
10	PENTATRIACONTANE	77224.	0.883		3.80
11	4-OCTADECENAL	30931.	0.354		1.52
12	HEXATRIACONTANE	87023.	0.995		4.29
13	TETRACONTANE, 3,5,24-TRIMETHYL-	42426.	0.485		2.09
14	CYCLOHEXANE, 1-(1,5-DIMETHYLHEXYL)-4-(4-METHYLPENTYL)-	39190.	0.448		1.93
15	4-HEXENOIC ACID, 3-METHYL-2,6-DIOXO-	29624.	0.337		1.41
16	1,2-BENZENEDICARBOXYLIC ACID, DIBUTYLESTER	66844.	0.764		3.29
17	3-OCTADECENAL	38784.	0.443		1.91
18	EICOSANE, 9-CYCLOHEXYL-	33924.	0.388		1.67
19	1-HENTETRACONTANOL	27029.	0.309		1.33
20	1,2-BENZENEDICARBOXYLIC ACID, DIISOOCTYLESTER	39520.	0.452		1.95

FIGURE 6

THUNDER BAY TGS SHAKE TEST/AQUEOUS EXTRACT

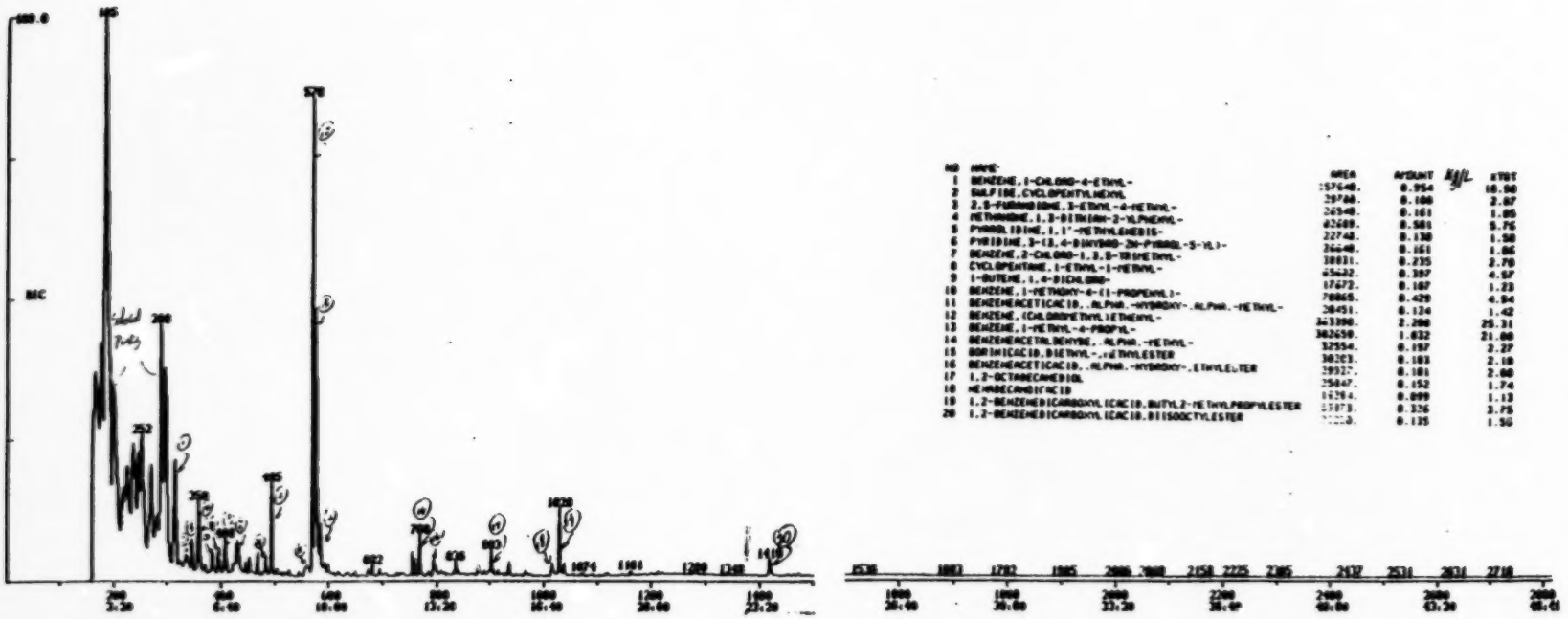


NO	NAME	AREA	AMOUNT	ppb	%TOT
1	BENZENEETHANOL, 3-CHLORO-	132264.	0.010		4.41
2	PETHANONE, 1,3-DITHIAN-2-YLPHENYL-	79260.	0.405		2.64
3	BENZENE, 1,1'-(1,2-DIPETHYL-1,2-ETHANEDIYL)BIS-, .ALPHA.-(4-, .ALPHA.)-	23516.	0.144		0.78
4	BENZENE, 2-CHLORO-1,3,5-TRIETHYL-	66505.	0.467		2.22
5	1-BUTENE, 1,4-DICHLORO-	35295.	0.216		1.18
6	BENZENE, 1-PETHOXY-4-(1-PROPENYL)-	21432.	0.131		0.71
7	BENZENE, (1,2-DIPETHOXYETHYL)-	55250.	0.338		1.84
8	BENZENEPETHANOL, .ALPHA.-ETHENYL-	1763148.	10.000		58.73
9	BENZENEACETAL DEHYDE, .ALPHA.-PETHYL-	114495.	0.701		3.81
10	2-ONETHANONE, 4-(2,6,6-TRIMETHYL-1,3-HEXADIENYL)-	30885.	0.189		1.03
11	BENZOICACID, 2,4-DIPETHYL-, PETHYLESTER	62480.	0.382		2.08
12	1,2-OCTADECANEDIOL	33150.	0.203		1.10
13	BORINICACID, DIETHYL-, PETHYLESTER	55035.	0.337		1.83
14	BENZENEACETICACID, .ALPHA.-HYDROXY-, ETHYLESTER	34239.	0.210		1.14
15	TETRADECANOICACID	47781.	0.292		1.59
16	ISOHEPTADECANOL	47586.	0.292		1.59
17	HEXADECANOICACID	61170.	0.375		2.04
18	1,2-BENZENEDICARBOXYLICACID, BUTYL2-PETHYLPROPYLESTER	258824.	1.585		8.62
19	1,2-OCTADECANEDIOL	35421.	0.218		1.18
20	1,2-BENZENEDICARBOXYLICACID, DIISOOCTYLESTER	43157.	0.272		1.48

FIGURE 7

NANTICOKE TGS BOTTOM ASH SLUICE WATER

164798 RD



NO	NAME	AREA	AMOUNT	Kg/L	XTOT
1	BENZENE, 1-CHLORO-4-ETHYL-	1576+0.	0.954		10.50
2	SULFIDE, CYCLOPENTYL HEXYL	29760.	0.180		2.07
3	2,5-PYRROLIDINE, 3-ETHYL-4-METHYL-	26540.	0.161		1.85
4	METHANONE, 1,3-DIETHIENH-2-YL PHENYL-	42689.	0.581		5.75
5	PYRROLIDINE, 1,1'-METHYLENEBIS-	22740.	0.138		1.58
6	PYRIDINE, 3-(3,4-DIHYDRO-2H-PYRROL-5-YL)-	26640.	0.161		1.85
7	BENZENE, 2-CHLORO-1,3,5-TRIMETHYL-	38831.	0.235		2.70
8	CYCLOPENTANE, 1-ETHYL-1-METHYL-	65632.	0.397		4.57
9	1-BUTENE, 1,4-DICHLORO-	17672.	0.107		1.23
10	BENZENE, 1-METHOXY-4-(1-PROPENYL)-	70865.	0.429		4.94
11	BENZENEACETIC ACID, .ALPHA.-HYDROXY-, ALPHA.-METHYL-	20451.	0.124		1.42
12	BENZENE, (CHLOROMETHYL)METHOXY-	363390.	2.200		25.31
13	BENZENE, 1-METHYL-4-PROPYL-	3632590.	1.832		21.00
14	BENZENEACETALDEHYDE, .ALPHA.-METHYL-	32954.	0.197		3.27
15	BORINIC ACID, DIETHYL-, ETHYLESTER	36203.	0.183		2.10
16	BENZENEACETIC ACID, .ALPHA.-HYDROXY-, ETHYLESTER	39327.	0.181		2.60
17	1,2-OCTANEDIOL	25647.	0.152		1.74
18	HEXADECANOIC ACID	16794.	0.099		1.13
19	1,2-BENZENEDICARBOXYLIC ACID, BUTYL 2-METHYLPROPYL ESTER	13873.	0.326		3.73
20	1,2-BENZENEDICARBOXYLIC ACID, DIISOOCTYL ESTER	[illegible]	0.135		1.56

FIGURE 8

NANTICOKE TGS FLY ASH SLUIDE WATER

164799 RD

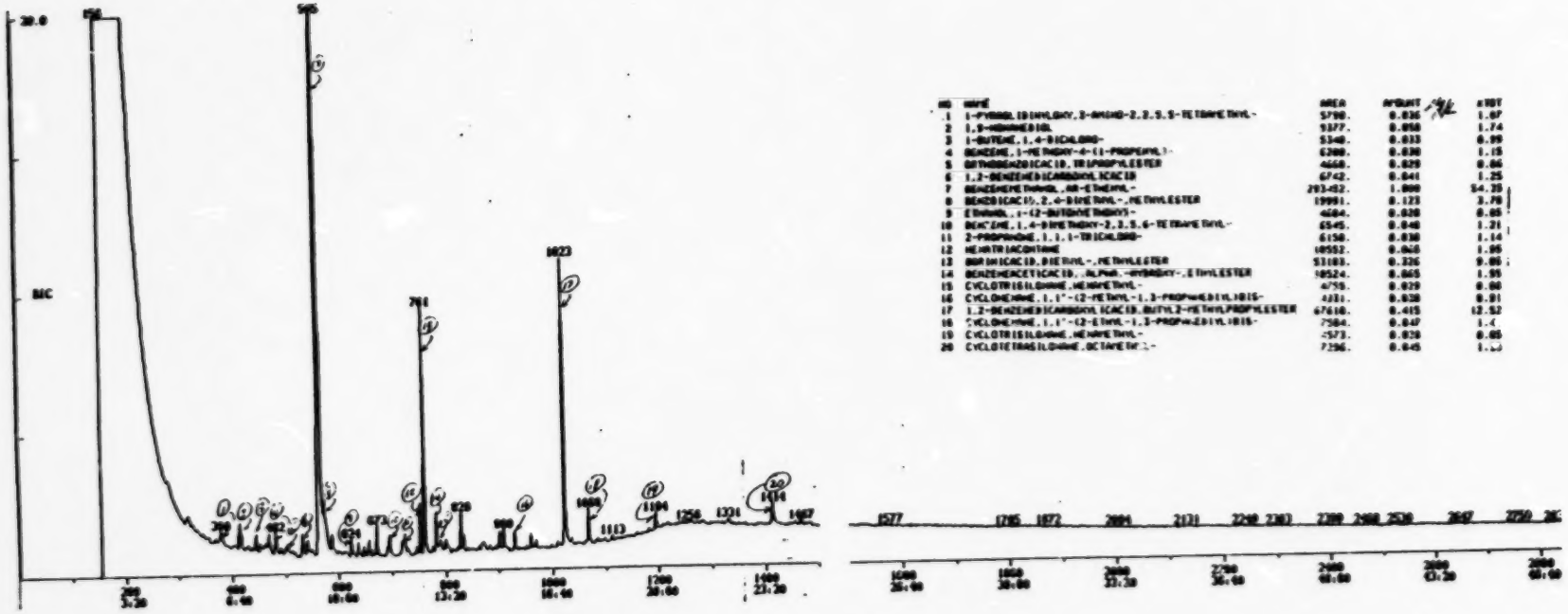
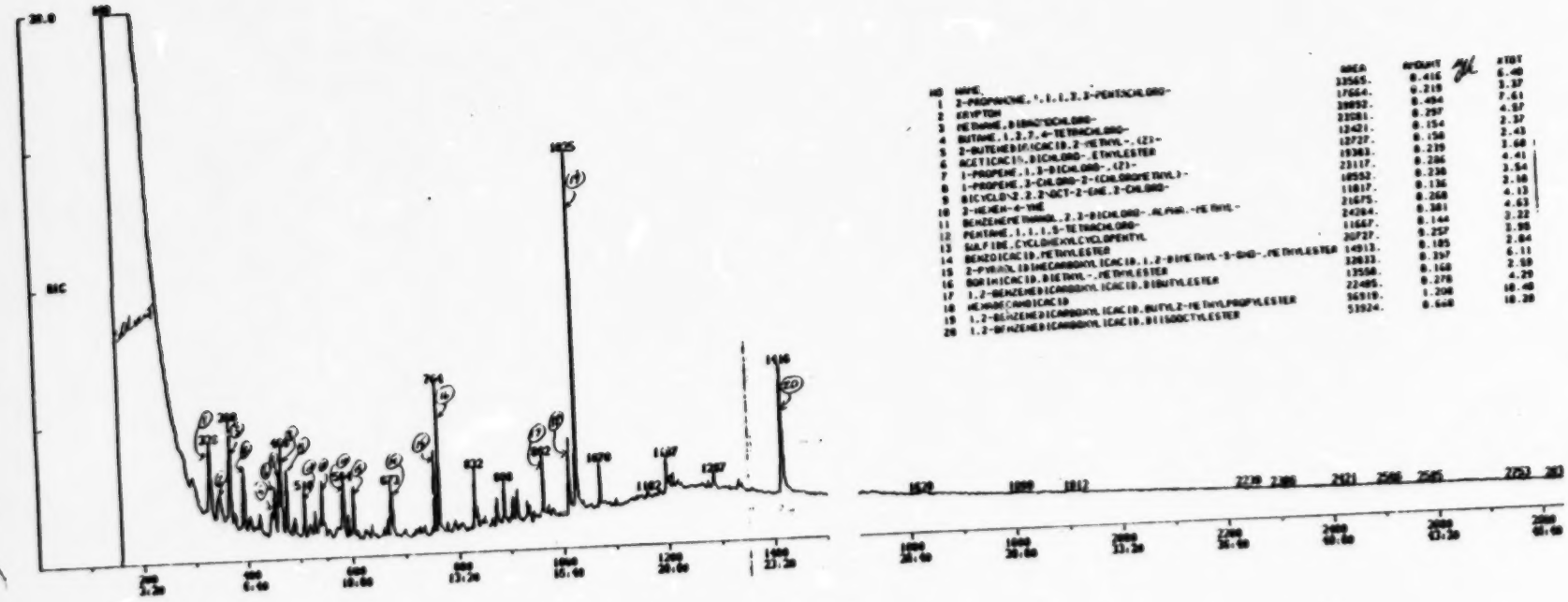


FIGURE 9

NANTICOKE TGS, FLY ASH AND BOTTOM ASH
MIXED SLUICE WATER

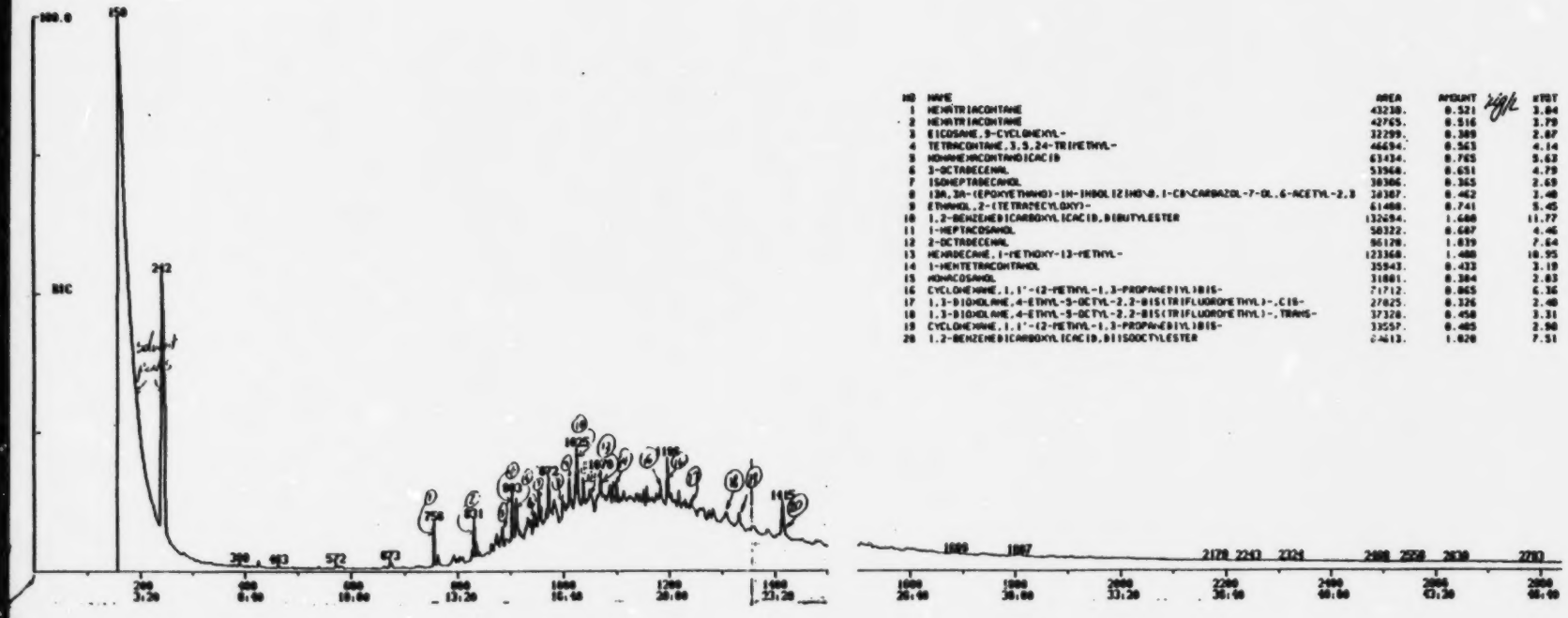


NO	NAME	AREA	WEIGHT %	RT
1	2-PROPANONE, *,1,1,3,3-PENTACHLORO-	33565.	0.416	6.40
2	KRYPTON	17664.	0.219	3.37
3	METHANE, DIBROTOCHLORO-	39892.	0.494	7.61
4	BUTANE, 1,2,2,4-TETRACHLORO-	23581.	0.297	4.57
5	2-BUTENEDIOIC ACID, 2-METHYL-, (Z)-	12421.	0.154	2.37
6	ACETIC ACID, DICHLORO-, ETHYLESTER	12727.	0.158	2.43
7	1-PROPENE, 1,3-DICHLORO-, (Z)-	19383.	0.239	3.68
8	1-PROPENE, 3-CHLORO-2-(CHLOROMETHYL)-	23117.	0.286	4.41
9	BICYCLO[2.2.2]OCT-2-ENE, 2-CHLORO-	18552.	0.230	3.54
10	2-HEXEN-4-YNE	11817.	0.136	2.10
11	BENZENEMETHANOL, 2,3-DICHLORO-, ALPHA.-METHYL-	21675.	0.268	4.13
12	PENTANE, 1,1,1,3-TETRACHLORO-	24384.	0.301	4.63
13	SULFIDE, CYCLOHEXYLCYCLOPENTYL	11647.	0.144	2.22
14	BENZOIC ACID, METHYLESTER	20737.	0.257	3.95
15	2-PYRROLIDINECARBOXYL ICACID, 1,2-DIMETHYL-5-OXO-, METHYLESTER	14913.	0.185	2.84
16	BORIN ICACID, DIETHYL-, METHYLESTER	32833.	0.397	6.11
17	1,2-BENZENEDICARBOXYL ICACID, DIBUTYLESTER	13560.	0.168	2.58
18	HEXANOIC ACID ICACID	22495.	0.278	4.29
19	1,2-BENZENEDICARBOXYL ICACID, BUTYL2-METHYLPROPYLESTER	16919.	1.208	10.40
20	1,2-BENZENEDICARBOXYL ICACID, DIISOOCTYLESTER	53924.	0.668	10.20

FIGURE 10

LAKEVIEW TGS BOTTOM ASH LAGOON

164801 RD



NO	NAME	AREA	AMOUNT	RT
1	HENATRIACONTANE	43230.	0.521	3.84
2	HENATRIACONTANE	42765.	0.516	3.79
3	EICOSANE,9-CYCLOHEXYL-	32299.	0.389	2.87
4	TETRACONTANE,3,5,24-TRIMETHYL-	46694.	0.563	4.14
5	HONANEHACONTANOICACID	63434.	0.765	5.63
6	3-OCTADECENAL	53968.	0.651	4.79
7	ISOHEPTADECANOL	38306.	0.365	2.69
8	(3A,3B-(EPOXYETHANO)-1H-IMBOLIZINO\8,1-CB\CARBAZOL-7-OL,6-ACETYL-2,3	24387.	0.462	3.40
9	ETHANOL,2-(TETRADECYLOXY)-	61488.	0.741	5.45
10	1,2-BENZENEDICARBOXYLICACID,DIBUTYLESTER	132694.	1.600	11.77
11	1-HEPTACOSANOL	58322.	0.687	4.46
12	2-OCTADECENAL	96128.	1.039	7.64
13	HEXADECANE,1-METHOXY-13-METHYL-	123368.	1.488	10.95
14	1-HENTETRACONTANOL	35943.	0.433	3.19
15	HONACOSANOL	31881.	0.384	2.83
16	CYCLOHEXANE,1,1'-(2-METHYL-1,3-PROPANEDIYL)BIS-	71712.	0.865	6.36
17	1,3-DIOXOLANE,4-ETHYL-5-OCTYL-2,2-BIS(TRIFLUOROETHYL)-,CIS-	27025.	0.326	2.40
18	1,3-DIOXOLANE,4-ETHYL-5-OCTYL-2,2-BIS(TRIFLUOROETHYL)-,TRANS-	37328.	0.450	3.31
19	CYCLOHEXANE,1,1'-(2-METHYL-1,3-PROPANEDIYL)BIS-	33557.	0.405	2.98
20	1,2-BENZENEDICARBOXYLICACID,DIISOOCTYLESTER	84413.	1.020	7.51

FIGURE 11

LAKEVIEW TGS CHEMICAL TREATMENT LAGOON

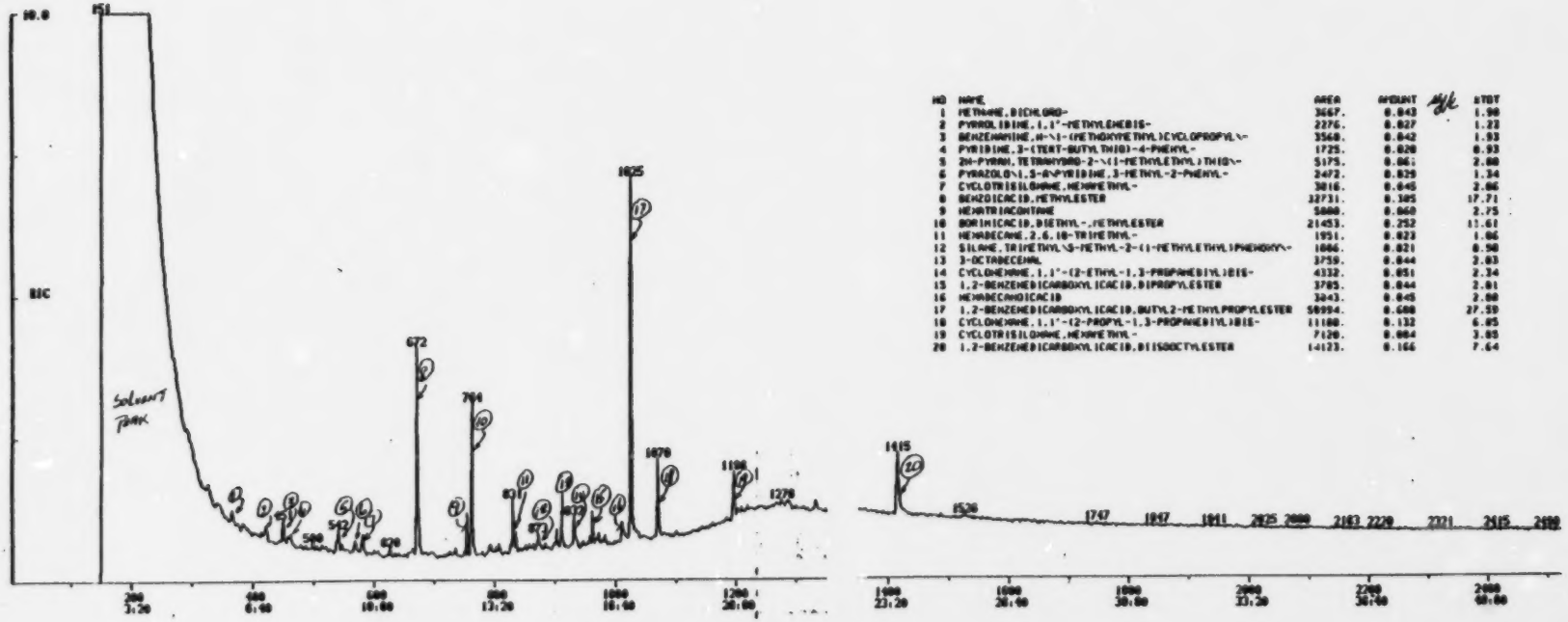
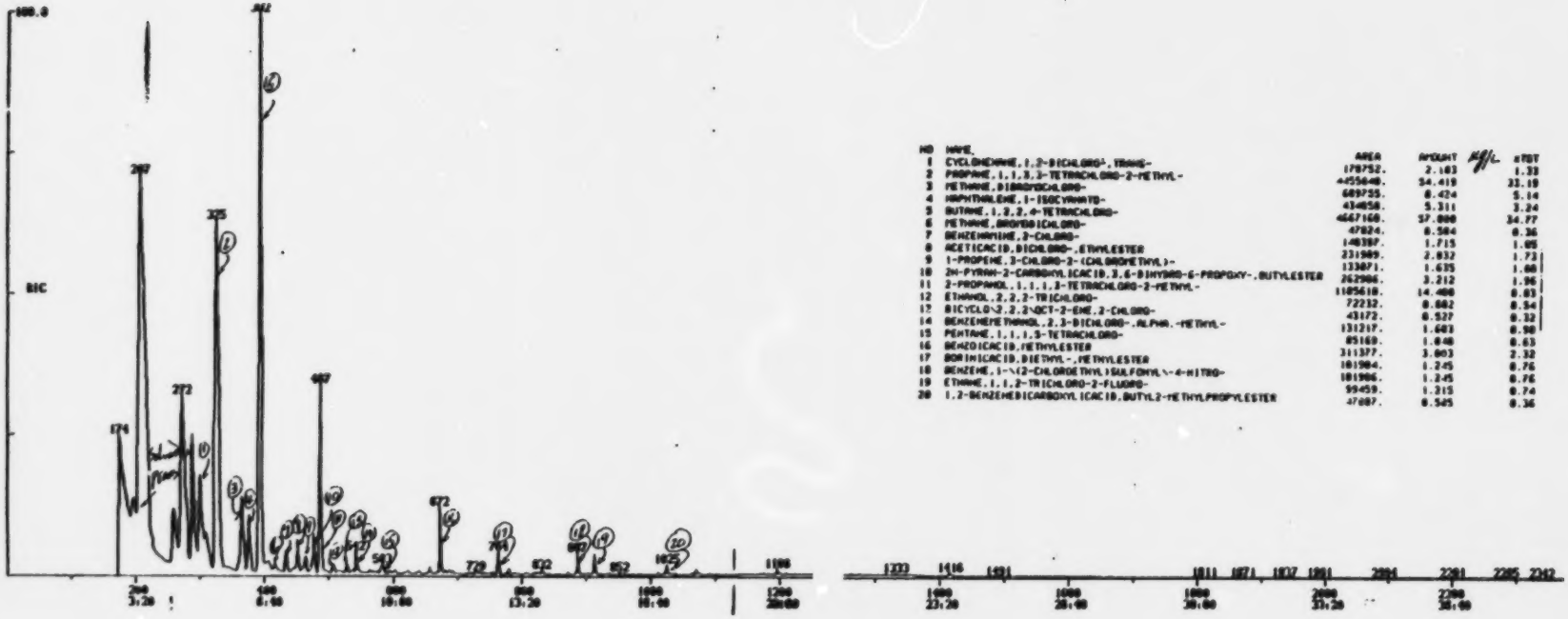


FIGURE 12

LAKEVIEW TGS WEST COAL PILE DRAINAGE

164803 RD

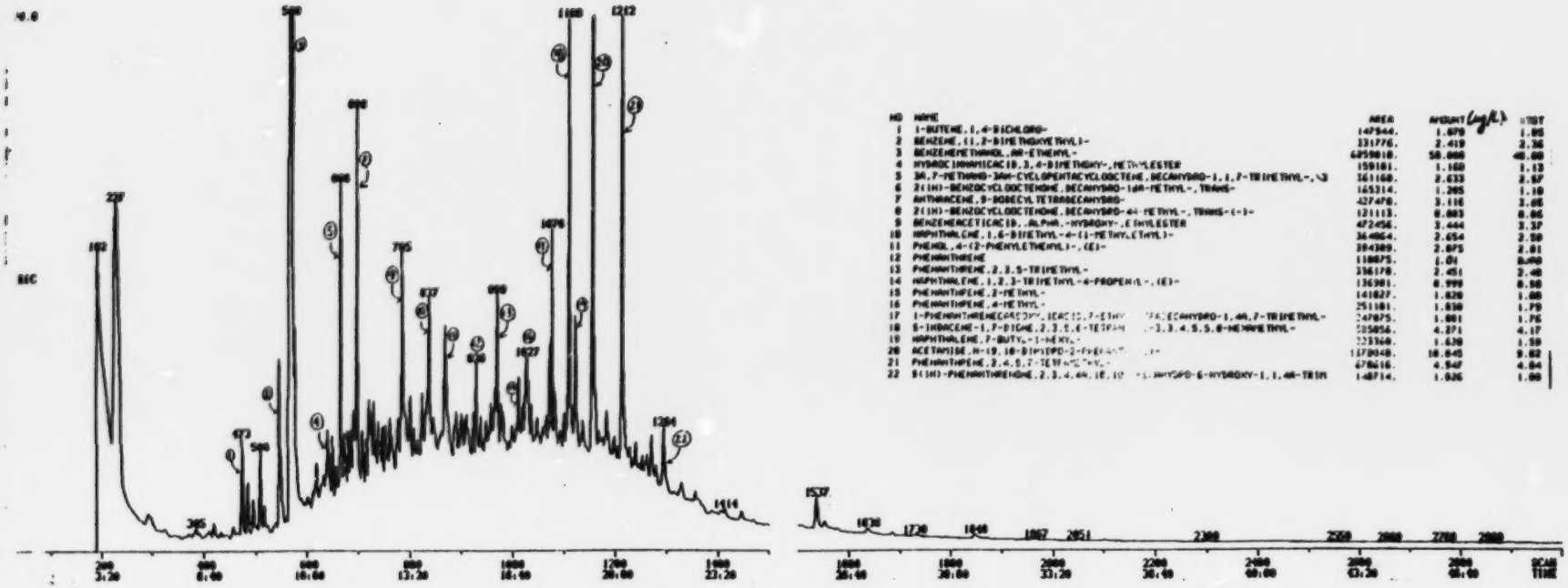


NO	NAME	AREA	AMOUNT	MW	RET
1	CYCLOHEXANE, 1,2-DICHLORO-, TRANS-	179752.	2.103		1.33
2	PROPANE, 1,1,3,3-TETRACHLORO-2-METHYL-	4455648.	54.419		33.19
3	METHANE, DIBROMOCHLORO-	689755.	8.424		5.14
4	NAPHTHALENE, 1-ISOCYANATO-	434858.	5.311		3.24
5	BUTANE, 1,2,2,4-TETRACHLORO-	4647168.	57.800		34.77
6	METHANE, DIBROMODICHLORO-	47824.	0.584		0.36
7	BENZENAMINE, 2-CHLORO-	140387.	1.715		1.05
8	ACETIC ACID, DICHLORO-, ETHYLESTER	231989.	2.832		1.73
9	1-PROPENE, 3-CHLORO-3-(CHLOROETHYL)-	133871.	1.635		1.00
10	2H-PYRAN-2-CARBOXYLIC ACID, 3,6-DIHYDRO-6-PROPOXY-, BUTYLESTER	262986.	3.212		1.96
11	2-PROPANOL, 1,1,1,3-TETRACHLORO-2-METHYL-	1185618.	14.480		8.83
12	ETHANOL, 2,2,2-TRICHLORO-	72232.	0.882		0.54
13	BICYCLO[2.2.2]OCT-2-ENE, 2-CHLORO-	43172.	0.527		0.32
14	BENZENEMETHANOL, 2,3-DICHLORO-.ALPHA.-METHYL-	131217.	1.601		0.98
15	PENTANE, 1,1,1,3-TETRACHLORO-	85160.	1.040		0.63
16	BENZOIC ACID, METHYLESTER	311377.	3.803		2.32
17	BORINIC ACID, DIETHYL-, METHYLESTER	181984.	1.245		0.76
18	BENZENE, 1-[(2-CHLOROETHYL)SULFONYL]-4-NITRO-	181986.	1.245		0.76
19	ETHANE, 1,1,2-TRICHLORO-2-FLUORO-	99459.	1.215		0.74
20	1,2-BENZENEDICARBOXYLIC ACID, BUTYL 2-METHYLPROPYL ESTER	47887.	0.585		0.36

FIGURE 13

BIRCHWOOD PARK BOREHOLE SAMPLE

164804 RD

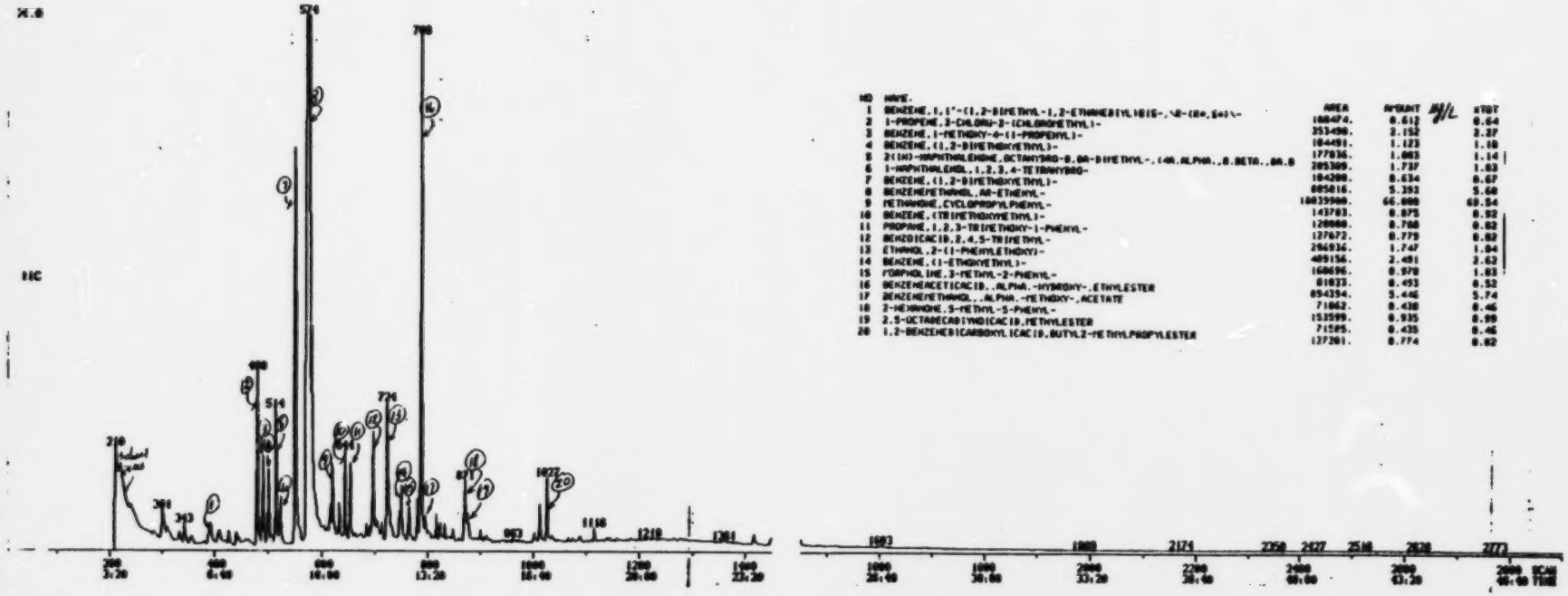


NO	NAME	AREA	AMOUNT (ug/L)	%TOT
1	1-BUTENE,1,4-DICHLORO-	147544.	1.670	1.05
2	BENZENE,(1,2-DIMETHOXYETHYL)-	331776.	2.419	2.36
3	BENZENEMETHANOL,AR-ETHENYL-	6259818.	50.000	40.00
4	HYDROCINNAMICACID,3,4-DIMETHOXY-,METHYLESTER	159181.	1.160	1.13
5	3H,7-METHANO-3AH-CYCLOPENTACYCLOOCTENE,DECAHYDRO-1,1,7-TRIMETHYL-,(3	361160.	2.633	2.57
6	2(1H)-BENZOCYCLOOCTENONE,DECAHYDRO-1AH-METHYL-,TRANS-	165314.	1.205	1.18
7	ANTHRACENE,9-DODECYLTETRADECAHYDRO-	427470.	3.116	3.05
8	2(1H)-BENZOCYCLOOCTENONE,DECAHYDRO-4A-METHYL-,TRANS-(-)-	121113.	0.883	0.86
9	BENZENEACETICACID,.ALPHA.-HYDROXY-,ETHYLESTER	472456.	3.444	3.37
10	NAPHTHALENE,1,6-DIMETHYL-4-(1-METHYLETHYL)-	364864.	2.654	2.59
11	PHENOL,4-(2-PHENYLETHENYL)-,(E)-	384389.	2.875	2.81
12	PHENANTHRENE	118675.	1.01	0.90
13	PHENANTHRENE,2,3,5-TRIMETHYL-	336178.	2.451	2.40
14	NAPHTHALENE,1,2,3-TRIMETHYL-4-PROPENYL-,(E)-	136981.	0.999	0.98
15	PHENANTHRENE,2-METHYL-	141827.	1.020	1.00
16	PHENANTHRENE,4-METHYL-	251181.	1.830	1.79
17	1-PHENANTHRENECARBOXY,1CACID,7-ETHY [illegible],ECAHYDRO-1,4A,7-TRIMETHYL-	247875.	1.801	1.76
18	6-INDACENE-1,7-DICHE,2,3,5,6-TETRAH [illegible]-1,3,4,5,5,8-HEXAMETHYL-	585856.	4.271	4.17
19	NAPHTHALENE,7-BUTYL-1-HEXYL-	223360.	1.630	1.59
20	ACETAMIDE,N-(9,10-DIHYDRO-2-PHENAN [illegible]-YL-	1270048.	10.045	9.82
21	PHENANTHRENE,2,4,5,7-TETRAMETHYL-	478616.	4.547	4.64
22	9(1H)-PHENANTHRENONE,2,3,4,4A,10,10 [illegible]-HYDRO-6-HYDROXY-1,1,4A-TRIM	148714.	1.926	1.88

FIGURE 14

THUNDER BAY LIGNITE PILE RUNOFF

164805 RD



NO	NAME	AREA	AMOUNT	%/L	%TOT
1	BENZENE,1,1'-(1,2-DIMETHYL-1,2-ETHANEDIYL)BIS-,(R*,S*)-	188474.	0.611		0.64
2	1-PROPENE,3-CHLORO-2-(CHLOROMETHYL)-	353490.	2.152		2.27
3	BENZENE,1-METHOXY-4-(1-PROPENYL)-	184491.	1.123		1.18
4	BENZENE,(1,2-DIMETHOXYETHYL)-	177836.	1.083		1.14
5	2(1H)-NAPHTHALENONE,OCTAHYDRO-8,8A-DIMETHYL-,(4R,4ALPHA,,8.BETA.,8A.B	285309.	1.737		1.83
6	1-NAPHTHALENOL,1,2,3,4-TETRAHYDRO-	104200.	0.634		0.67
7	BENZENE,(1,2-DIMETHOXYETHYL)-	895816.	5.353		5.68
8	BENZENEMETHANOL,AR-ETHENYL-	10039960.	66.000		63.54
9	METHANONE,CYCLOPROPYLPHENYL-	143783.	0.875		0.92
10	BENZENE,(TRIMETHOXYMETHYL)-	129888.	0.790		0.83
11	PROPANE,1,2,3-TRIMETHOXY-1-PHENYL-	127672.	0.779		0.82
12	BENZOICACID,2,4,5-TRIMETHYL-	286936.	1.747		1.84
13	ETHANOL,2-(1-PHENYLETHOXY)-	409156.	2.491		2.62
14	BENZENE,(1-ETHOXYETHYL)-	168696.	0.978		1.03
15	MORPHOLINE,3-METHYL-2-PHENYL-	81033.	0.493		0.52
16	BENZENEACETICACID,.ALPHA.-HYDROXY-,ETHYLESTER	894354.	5.446		5.74
17	BENZENEMETHANOL,.ALPHA.-METHOXY-,ACETATE	71862.	0.438		0.46
18	2-HEXANONE,5-METHYL-5-PHENYL-	153599.	0.935		0.98
19	2,5-OCTADECADIYNOICACID,METHYLESTER	71595.	0.435		0.46
20	1,2-BENZENEDICARBOXYLICACID,BUTYL2-METHYLPROPYLESTER	127201.	0.774		0.82

FIGURE 15

THUNDER BAY LIGNITE BOTTOM ASH SLUICE WATER

164806 RD

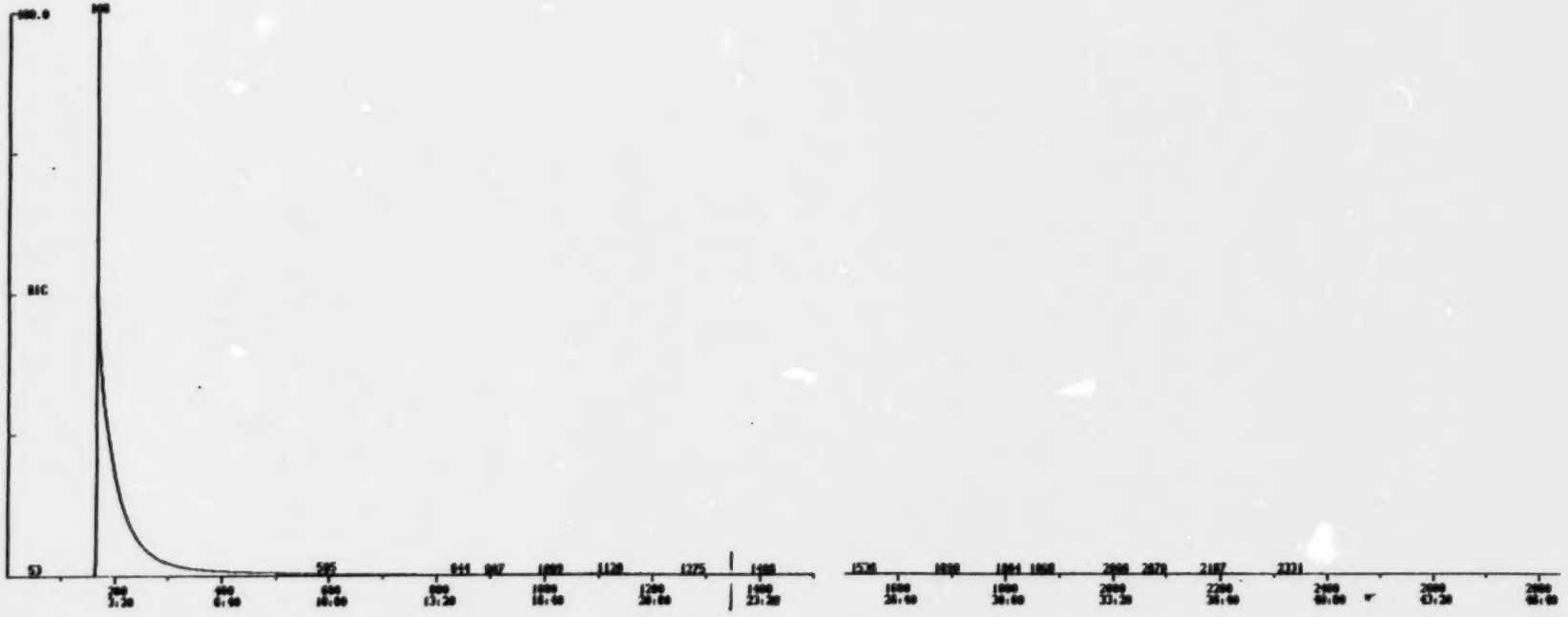


FIGURE 16

500 mL CH_2Cl_2 BLANK

TABLE 3 Summary of PAH's Found in All Samples

SAMPLE		PAH FOUND	Concentration in ug/L or Otherwise Specified		
1	(1)	phenanthrene	0.64	ug/kg	ash
	(2)	naphthalene	40	ug/kg	*
	(3)	naphthalene-1-methyl	5	ug/kg	*
	(4)	naphthalene-2-methyl	5	ug/kg	*
2		ND	-		
3	(1)	phenanthrene	0.77	ug/kg	ash
	(2)	naphthalene	287	ug/kg	*
	(3)	naphthalene-1-chloromethyl	205	ug/kg	*
4	(1)	phenanthrene	0.38	ug/kg	
5	(1)	phenanthrene	0.006		
6	(1)	phenanthrene	0.019		
7	(1)	phenanthrene	0.01		
8	(1)	phenanthrene	0.01		
9	(1)	phenanthrene	0.01		
10		ND	-		
11	(1)	phenanthrene	0.005		
12		ND	-		
13	(1)	naphthalene-1-isocyanato	5.31	*	
14	(1)	phenanthrene	1.01		
	(2)	anthracene,9-dodecyl tetra-decahydro	3.16	*	
	(3)	trimethyl phenanthrene	2.45	*	
	(4)	2-methyl phenanthrene	1.03		
	(5)	4-methyl phenanthrene	1.83		
	(6)	1-phenanthrene carboxylicacid 7-ethyltetradecahydro-1,4A, 7-trimethyl	1.80	*	
	(7)	acetamide,N-(9,10 dihydro-2-phenanthryl)	10.0	*	
	(8)	tetramethyl phenanthrene	4.94	*	
	(9)	9(1H)-phenanthrene,2,3,4,4A, 10,10A hexahydro-6-hydroxy-1 1,1,4A-trim	1.03	*	
	(10)	methyl pyrene	0.50	*	
	(11)	fluoranthene	0.73		
	(12)	pyrene	0.92		
	(13)	naphthalene-1,6-dimethyl-4-(1-methyl ethyl)	2.65	*	

SAMPLE		PAH FOUND	Concentration in ug/L or Otherwise Specified	
	(14)	naphthalene 1,2,3-trimethyl-4-propeny-(E)-	1.00	*
	(15)	naphthalene, 7-butyl-1-hexyl	1.63	*
15	(11)	phenanthrene	0.01	

* Estimated amount only (standards not available)
ND = None were detected

TABLE 4 PAH's in some Fuel Oils /OHRD Reports CO81-1127 & CO81-1217-K

Polynuclear Aromatic Compounds (PAH) in Fuel Oils

SAMPLE ID	FILE NAME	PAH IDENTIFIED	CONCENTRATION, mg/L OF OIL
SIMCOE Apirl 21	(B821)	Naphthalene	1290
		Methyl fluorene	1020
		Phenanthrene	1030
		Methyl phenanthrene	2050
		Dimethyl phenanthrene	750
		Trimethyl phenanthrene	115
SIMCOE April 22	(C821)	Naphthalene	1180
		Methyl fluorene	850
		Phenanthrene	960
		Methyl phenanthrene	2230
		Trimethyl phenanthrene	160
MILTON April 27	(A821)	Naphthalene	980
		Methyl fluorene	890
		Phenanthrene	1190
		Methyl phenanthrene	2400
		Dimethyl phenanthrene	1350
		Trimethyl phenanthrene	100